Abstract

1. Shifting from annual monocultures to perennial polycultures has been described as the future of modern agriculture. Perennial polycultures can increase resilience of agricultural systems which must remain productive despite increasing environmental and societal pressures. However, such systems provide a unique challenge for experimental research and testing of scientific hypotheses because of their inherent complexity across spatial and temporal scales.
2. In this Perspective, we examine current approaches to data analysis and sampling strategies of bio-physico-chemical indicators in European temperate agroforestry systems i.e., a subtype of perennial polyculture that combines arable and grassland management with tree cultivation. We noted that multilevel models which offer a practical solution to many field-specific concerns such as pseudo-replication and hierarchical data structures, are currently underused in agroforestry research.
3. We aim to facilitate the use of multilevel models in agroforestry research by providing a follow-along working R code that illustrates a few key concepts presented in this paper, e.g., different methods of accounting for spatial autocorrelation and parametrization of the variance-covariance structure, together with a crop yield dataset from a recently established agroforestry system in central Germany.
4. We highlight the importance of model diagnostics for causal inference in agroforestry research as well as thoughtful design of sampling strategies to avoid hasty conclusions regarding the impact of trees on the crop yield in early-stage perennial polyculture systems.